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THESIS

Gamification in European Education - Methods and Policies

Postgraduate Student Name: Khattari Markos

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1. Introduction

- *"All work and no play makes Jack a dull boy."* (English proverb)

1.1 Preamble

We all play. Research shows that among animals, play has both immediate and long term developmental benefits. With games and game-like elements present in most aspects of everyday life, the promotion of desired behaviours through gamification has expanded from brushing one's teeth in the morning to checking-in at the restaurant before dinner in order to qualify for a discount (Lee & Hammer, 2011).

1.2 Structure of thesis

The thesis aims to present the use of gamification methods in education, the integration of the practice in European education and speculate on its effect and results.

Initially, a thorough literature review is conducted in Chapter 2, to define Gamification and the education methods it is used along with. A short presentation follows, describing recent calls for gamification in education by research programmes that are financially supported by the European Union. Chapter 2 is concluded with applications of gamification that are used in European funded projects.

In Chapter 3 the methodology of the research is presented and the research questions are set. Chapter 4 presents European funded projects that research the efficiency of gamification in educational and training environments as well as their results.

Finally, the conclusions along with recommendations for further research are presented in Chapter 5.

2. Literature review

2.1 Introduction

Gamification is defined as the application of elements of game playing such as point scoring, competition with others, rules of play, to other areas of activity to encourage engagement with a product or service.

Sangkyun Kim presents several definitions from the bibliography where gamification is described as the process of changing something that is not a game, using a game or its elements. It can also be a means to engage employees in tasks, promote collaboration or improve motivation (Kim, Song, Lockee & Burton, 2018). Furthermore, Sebastian Deterding suggested the definition of "gamification" to be "the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled & Nacke, 2011). In the scope of using gamification in education, Kim proposes the definition as *"a set of activities and processes to solve problems related to learning and education by using or applying the game mechanics"* (Kim et al., 2018).

Gamification is not only present in aspects of education and training but also in work environments, motivating employees to be more productive and engaged in their tasks, promoting and improving motivation. While being difficult to pinpoint the historical origin of the concept, gamification practices have been used in the military in the form of ranks and badges. The Boy Scouts of America, have been handing out merit badges since 1911, motivating their members to achieve goals, seek mastery and reputation with their accomplishments (written by Judd Antin in Deterding S., 2012). In everyday life, retail stores issue coupons to be collected through purchases and subsequently be exchanged for various products. In the travel industry, frequent flyer programs have been implemented since the 1980s allowing exchange of "miles" collected in lieu of points to be exchanged for services or even free trips (Kim et al., 2018).

2.2 Methods of Gamified Learning

2.2.1 Gamification

The term gamification in academic literature first appears in Johan van Benthem's discussion of logic games that any logical task can be gamified by presenting or converting a non-game task into a game using game elements and game design, in an attempt to make the

experience more engaging (Landers, 2014).

The digital media industry has been documented using the term since 2008 and in 2011, Deterding proposed a working definition for gamification *"as the use of game design elements in non-game contexts"* (Deterding et al., 2011). Similarly, in an attempt to simply define gamification, Wood & Reiners proposed a different definition. According to them, gamification is *"unrestricted in its application, environment, or discipline: Gamification is a designed behaviour shift through playful experiences"* (Wood & Reiners, 2015).

Another way to summarise gamification is *"the process of making activities more game-like"*. It fits what gamification is today, captures the essential aspects of the practice and provides valuable direction for the future. (Werbach, 2014).

2.2.2 Serious Games

The definition of the term "serious game" often varies depending on who uses it and in what context (Breuer & Bente, 2012). The related domains of e-learning, edutainment, game-based and digital game-based learning sometimes overlap with the domain of serious games, making a commonly accepted definition difficult to determine (Susi, Johannesson & Backlund, 2007). Tarja Susi differentiates serious games from gamification since the former is defined as a full-fledged game designed for non-entertainment purposes, while gamified applications merely employ elements found in games and do not give rise to entire games (ibid.).

Breuer locates the first formulation of the term in Clark C. Abt's book "*Serious Games*" written in 1975. He argues that while serious games can be created to serve an educational purpose, that doesn't always have to be the case as a game originally designed for entertainment can be used in training using the game as a medium for the learning process to happen (Breuer, 2012).

Initially the term sought to apply video game elements to boost the engagement and augment the experience of the trainees, while ushering them to specific targeted behaviours (Landers, 2014). Serious game players are expected to be in a process of learning while they are playing the game and to have achieved the learning objectives as they successfully complete the missions in the game (Kim et al., 2018).

Landers highlights the main difference between gamification and serious games by the presence of game attributes, elements such as rules and goals, game fiction, human interaction and immersion. *"In serious games, all of these attributes are present, but vary in*

degree. In gamified learning, specific game attributes are targeted, extracted, and adapted to non-game contexts" (Landers, 2014). He also states that *"Although games may also affect learner motivation or engagement, it is not generally the purpose of serious games to affect these characteristics without also providing the learner with instructional content. In contrast, gamification practitioners do not generally seek to influence learning directly; instead, the goal of gamification is to alter a contextual learner behavior or attitude (e.g., engagement), and which is intended to improve pre-existing instruction as a consequence of that behavioral or attitudinal change"* (Landers, 2014).

On the other hand Kim proposes that "*the purpose of gamification in learning and education is to create real-world environments that support learning and problem solving. It is implemented within the real world*" and as such, it should be used integrated with serious games (Kim et al., 2018).

It can be concluded that while differentiated according to the presence of game attributes, serious games can be an integral part of a gamification process in learning environments, delivering educational content while concurrently augmenting engagement, retention and effort for the trainees.

2.2.3 Playful Learning

Researchers have found that free play as well as guided play are essential for the development of academic and social skills and a central ingredient in learning. Furthermore, preschools that engage in more playful and child-centered approaches do better in test measuring language, reading, writing and mathematics, against ones that engage in teacher-directed approaches (Hirsh-Pasek & Golinkoff, 2008). Environments that promote play and provide play opportunities are at the core of effective pre-primary programmes and enable children to develop skills across all developmental domains, including motor, cognitive, social and emotional skills. These are critical in the formation of the more complex "21st-century skills", such as leadership, negotiation and conflict resolution, as well as self-advocacy (UNICEF, 2018).

While playful approaches are well understood and used in learning environments for younger children, they are not as common in higher education institutions. However, learning and teaching through play can be a stimulating approach that encourages adult creativity and imagination while constructing knowledge (L. Rice, 2009).

According to Price, playful learning should entail interaction with informational

artefacts in a way that involves fun and blurs the boundaries between play and learning. Fun and enjoyment support and deepen learning by facilitating engagement and motivation and therefore being effective in children's development (Price, 2003).

Active engagement in a learning activity *"has repeatedly been shown to be beneficial for learning"* (Rogers, Scaife, Stanton & Neale, 2003). The cognitive engagement of participating in an educational activity, increases attention, concentration and promotes learning. In turn, exploring the learning environment, manipulating haptic educational material in the classroom, *"promotes engagement, stimulates independent discovery and the interaction with different combinations of information enhances the learner's creativity"*(ibid.).

2.3 Gamification policies in European Education

The concept of gamification has evolved from a recent buzzword to an actual policy priority of the European Union that influences financial streams and is considered an innovative approach to learning, with funding calls directly focused on this notion since 2014 with "ICT-21-2014 - Advanced digital gaming/gamification technologies" (Perrotta, Bailey, Ryder, Haggis-Burridge & Persico 2019).

As the trajectories of gamification and gaming in European policy can affect the global socioeconomic and cultural positioning and purpose of games, we will investigate how the European Commission views the gamification approach with applications to education.

2.3.1 Horizon 2020

The interdisciplinary field of game studies as a topic of academic interest and an area of educational practice, is within the interests of the European Commission as articulated in the Horizon 2020 Research and Development programme concerned with ICT in general and more specifically with games.

Several funding calls were presented in H2020, where gamification and gaming were primary or secondary aspects. The "ICT 21 - 2014: Advanced digital gaming/gamification technologies", essentially defines gamification as viewed by the European Commission and states the expectancies of an investment in the field, envisioning the emergence of a prospering market. Additionally, the possibility for social inclusion of non-integrated groups is declared, stressing nonetheless the need for the development of new tools and methodologies accompanied by sufficient scientific evidence of the benefits gamification can bring for governments, enterprises and individuals.

Aiming to reinforce multidisciplinary research that includes technologies and components developed for the traditional digital game industry but in non-leisure contexts, the vision of a repository of core reusable, open components was introduced. This would allow anyone, from indie programmers to game publishers, to create games with applications focusing on learning and skills acquisition in formal and informal education, workplace learning and in policy making and collective social and public processes, ideally networking the research community in its broader range with traditional digital game players. The effectiveness of this approach would enable intermediaries and social actors, reach people at risk of educational exclusion.

The second call that was tied directly to gamification was “ICT-24-2016: Gaming and gamification”. Following the rapid growth of the software games business and their penetration into non-entertainment context applications that include education, training, research and health, the European research projects have identified roadmaps and secured resources and expertise that will enable the development of applied games in a faster, easier and cost-effective manner.

Supporting the expansion of applied gaming and gamification will lead to the creation of new solutions and methodologies, mainstreaming the application of gaming technologies, design and aesthetics to non-leisure contexts, with societal and economic benefits and the opportunity for small and medium enterprises to expand in new areas of business.

The scope of the project is to transfer technology from sectors different to the game industry into non-leisure situations, in order to create open gaming technologies and mechanics that will educate and motivate the participants. The use of modern gaming innovative technologies such as augmented and mixed reality, 3D audio and video, virtual worlds interactive storytelling, narratives, modelling and data, etc. combined with social science aspects such as potential risks and challenges, privacy, gender and ethical issues etc. curated by a collaboration of game developers, researchers from social science disciplines and the humanities, publishers, educational intermediaries and end-users, is expected to increase the implementation of gaming technologies in non-leisure contexts with focus on education and social inclusion.

In both the “ICT-19-2015: Technologies for creative industries, social media and convergence” call, and the “ICT-20-2017: Tools for smart digital content in the creative industries" video games are mentioned, but only in the context of easier creation and delivery of digital content. While the process of maximising the potential of content repurposing and

reuse in other contexts could be gamified, there is no mention of any such methodology or process.

The "ICT 20-2015: Technologies for better human learning and teaching" also includes gamification aspects as part of their challenge. It suggests game based learning as part of the framework to create a digital learning ecosystem that will reinforce Europe's leadership in adaptive learning technologies for the personalisation of learning experiences and facilitate the emergence of innovative businesses to create a digital learning ecosystem in Europe.

Finding its way in the area of healthcare, a gamified approach to physical training with motion tracking feedback has been proposed, as a way to approach health management holistically. In "PHC-26-2014: Self-management of health and disease: citizen engagement and mHealth", the use of devices to behaviourally adapt to the formation of healthy exercising habits through gamification, can also provide useful data to the training individual's health for personal use or utilisation by health professionals and public health monitoring authorities, effectively engaging patients in managing and treating their diseases, comorbidities, treatment adherence, rehabilitation, self-diagnostics and self-care.

"MG-4.5-2016: new ways of supporting development and implementation of neighbourhood-level and urban-district-level transport innovations", describes the need for new transport and mobility solutions that are socially and environmentally sustainable, calls for the emergence of innovative ideas and processes, such as a gamified approach to transportation that would redefine mobility in an urban environment.

Finally, while not clearly calling for games as an innovation action, "ICT-22-2016: Technologies for Learning and Skills" proposes the creation of "*environments for new learning experiences and experimentation"* including technologies that are prevalent in modern video games such as 3D simulation and modelling, along with augmented and virtual reality (Schofield, 2014).

Alongside Horizon 2020, the European Commission funded a sister project named "Gaming Horizons" in order to examine gaming and gamification as areas of research and development in Europe, "*adopting a multidisciplinary perspective based on the integration of the social sciences and the humanities, and proposing 'alternative framings' informed by criteria of responsible research and innovation*" (Perrotta et al., 2018).

The broad landscape analysis conducted under "Gaming Horizons" examined the state of the art regarding gaming and gamification. Involving stakeholders engaged with gaming research and practice, from various roles and capacities, it also addressed "issues such as

equality, social justice and ethical game mechanics, analysing emerging development practices and cultures in a consultative fashion, and paving the way for shared criteria of responsible self-governance" (Persico et al., 2017). Additionally, the project aims to assess the potential in the context of European research and innovation, in order to inform future European policies on the topic.

Finding that Gamification did not present the image of a powerful expressive medium but was still considered as an intrinsically problematic and time-wasting activity, it proposes a more nuanced and diverse approach regarding the study, development and use of games in various contexts as well as the revision of their framing for future funding.

By supporting research into learning design that will enable the educators to harness the potential of games for education, the European Commission can play a key role to the professional development of teachers, promoting the establishment of communities that will exchange information, know-how and experience through open repositories containing effective games and innovative lesson plans (Perrotta et al., 2018).

2.3.2 Horizon Europe

The European Commission Decision C(2021)4200, in the scope of "Culture, creativity and inclusive society", aims to enhance democratic governance and citizen participation, safeguard and promote cultural heritage as well as to respond to and shape multifaceted transformations on an cultural, economical, societal and technological level. Aiming to provide evidence-based policy options for a socially just and inclusive European green and digital transition and recovery, it mobilizes multidisciplinary European experts on the fields of social sciences and humanities.

In the call for activities contributing to the destination "Innovative Research on the European Cultural Heritage and the Cultural and Creative Industries", the topic of "Games and culture shaping our society" is proposed, requesting projects that analyze the impact of games on European society.

Specifically, the following expected outcomes are being presented:

- *Evidence of the impact of games on European society, including their cultural value and risks.*
- *Evidence of the innovation potential of games and play (on-line or other).*
- *New knowledge on the role of the games industry and non-commercial creative practices in the EU to benefit society.*

- *Improved knowledge of legal and intellectual property rights issues linked to the gaming population and games industry in the international markets.*
- *Proposals for improving games in terms of positive impact on education, skillset, responsible business models, employment chances, social cohesion and creativity.* (European Commission, 2021)

The rapid evolution of the gaming industry, appears to hamper the ability of researchers to thoroughly assess the impact games have on European society, culture and its cohesion and values. Addressing these matters is expected to unveil differences among age groups, gender and socioeconomic backgrounds. Additional variances may appear in game literacy and the digital divide.

In order to address the risks of social exclusion, intolerance and harassment that the digital game world can bring, policy options and actions are also desirable.

2.3.3 Specific Programme "Cooperation": Information and communication technologies

Recognizing the crucial role of information and communication technologies in boosting innovation, creativity and competitiveness through industrial and service sectors, the specific programme "Cooperation" aimed to capture this growth by investing in research and innovation for the next generation of technologies that will drive growth and sustainable development for the coming decades.

Through a wide range of applications including healthcare provision, transport systems, as well as innovative interactive systems for entertainment and learning, innovation in ICT opens up many new opportunities for European citizens and consumers. Aimed to improve illness prevention and safety of care, facilitate active participation of patients and enable personalization of care and also tackle problems associated with the ageing population, ICT research activities will cover strategic priorities in areas of European industrial and technological leadership, such as communication networks, embedded computing, nanoelectronics and technologies for audiovisual content.

Nearly half of the productivity gains in today's economy stem both from the production of innovative high value ICT-based goods and services and from improvements in business processes through the diffusion, adoption and use of ICTs across the economy.

Manufacturing, automotive, aerospace, pharmaceuticals, medical equipment and

agro-food, as well as financial services, media and retail have become ICT-intensive sectors and the benefits reported by firms, as a result of increased use of ICTs, include faster product development, cost and overhead reductions, faster and more reliable transactions, better relationships with customers and suppliers, improved levels of customer service and support, and enhanced collaboration opportunities.

Under the 7th Framework Program, information and communication technologies will benefit research in communication networks, embedded computing, nanoelectronics and technologies for audiovisual content, all strategic priorities of the European industrial and technological leadership.

2.3.4 Competitiveness and innovation framework programme (CIP) (2007-2013)

Aiming to make Europe the most competitive and dynamic knowledge-based economy in the world, the Lisbon European Council of March 2000 emphasized the importance of creating a climate favorable to small and medium-sized enterprises (SMEs).

As a coherent and integrated response to the objectives of the renewed Lisbon Strategy, the 'Competitiveness and innovation framework programme' (CIP) calls for actions to deliver growth and competitiveness, as well as make Europe a more attractive place to invest and work.

As one of the main Community measures to contribute to the generation of economic growth, the creation of more jobs and the support of competitiveness and innovation in the single market, it aims to bring together, into a coherent framework, specific Community support programmes and relevant parts of other programmes in the fields most critical to boosting European productivity, innovation capacity and sustainable growth, whilst also addressing complementary environmental concerns.

The combination of Community actions through CIP in the fields of entrepreneurship, SMEs, industrial competitiveness, innovation, ICT development and use, environmental technologies and intelligent energy complements the 'Seventh Community framework programme for research and technological development' (FP7) by dealing with innovation, which includes non-technological and technological innovation that has moved beyond the final demonstration phase and is ready for market replication.

2.4 Applications of gamification

In the field of learning and education, gamification is viewed as a set of activities and processes to solve problems related to learning and education by using or applying game mechanics. Among the variety of interventions used in education, the fun and playful nature of gamification has been observed as more effective and longer lasting than other solutions like the use of motivational strategies, in regards to learner engagement (Kim et al., 2018). While most schools already implement a reward system in the form of grades and recognition of performance which is awarded with advancement to the next class, they hardly manage to engage the majority of the students to the extent that games do. So, despite the presence of game-like elements, classroom based activities are not viewed as playful experiences and do not encourage students to engage in learning, hence the need to understand the circumstances under which gamification can drive learning behaviour (Lee & Hammer, 2011).

After the conceptualization of gamification the related studies, "*have covered many areas, from Economy to Education*" mostly focusing on the educational context (Toda, Vale & Isotani, 2017). As a term, gamification served as "*an umbrella term for the use of video game elements (rather than full-fledged games) to improve user experience and user engagement in non-game services and applications*" (Deterding et al., 2011).

2.4.1 Gamification Software and Tools

The field of education has taken advantage of technological advancement and the availability of the personal computer since the '80s, paving the way for many gamification tools. The emergence of faster internet and the always ready smart devices, paved the way to bring gamification applications and systems to the web along with specialized software. Gamified applications such as Duolingo for learning foreign languages, Grasshopper for coding, and LinkedIn Learning for a variety of business skills, run on smartphones making learning accessible at any time of the day.

2.4.2 Video Games

There is a plethora of software used for education that incorporate video game elements in various degrees or are developed as full fledged video games with a set purpose. Whether it is to teach a foreign language, typing, history, math, physics logic and other cognitive skills, the positive impact of video games has been observed especially regarding the retention of student's attention and engagement and providing hopeful results in children

with developmental, sensory or other learning abilities (Shaw, 2020). The field of education has taken advantage of the technological advancement and availability of computers, paving the way for many gamification tools. Regardless of the spread of video games in the education sector, there is insufficient integration of the principles of didactic design to the gameplay (Utoyo, 2018).

Characteristics of good video games can be used for learning content and skills relevant to school and professional work. By preparing players with a gentle learning curve, presenting doable but still challenging tasks, providing information in context and allowing them to understand the impact they have made in the game world through their actions, enables students to master the skills by engaging in a cycle that requires them to try harder to complete more difficult challenges as they increase in level. (Gonzalez & Area, 2013). This is described as the anchoring effect, where individuals gradually take on gradually more and more difficult challenges (Kim et al, 2018). On trainings that require simulation, computer-based and console-based games have become the focus of recent research and training, replacing the high fidelity simulation that were for decades the primary tool in employee development and training (Wilson et al., 2009).

Apart from being included in traditional classroom settings, game elements are also being incorporated in Learning Management Systems, websites and educational apps. The simple integration of game elements prepackaged modules, code snippets or even entire platforms, to any website, application or social network allows designers to create gamified learning environments without spending time in cumbersome development activities. Additionally, the current platforms often "*include analytics services, delivering integrated solutions that both incentivize and track users' behavior. So, companies also have, through these third-part services, powerful tools to gather information about their customers, such as engagement and retention rate, and offer them customized advertising and recommendations*" (Rapp, Hopfgartner, Hamari, Linehan & Cena, 2019).

Education has been always considered as a breeding ground for technology and while there is a growing literature on games and simulations used in the classroom, there are no comprehensive design paradigms or well-designed research studies available to incorporate them into the learning environment (Akkili, 2007).

2.4.3 Role Playing Games

As a system of rule-based storytelling, role playing games (RPGs), allow a group of players and a game director, usually called game master or narrator, to interact using their

imagination and collectively determine what is happening and how the story unfolds, in a series of social interactions and events for an improvisational-theater-like experience (Hawkes-Robinson, 2011). While role playing has existed since the dawn of humanity, and children pretend-play alone or with others experimenting with social roles, it is only recently that people have started to understand what a powerful educational tool it can be (Hirsh-Pasek & Golinkoff, 2008). Through this pretend or "symbolic" play, children express ideas, feelings and thoughts and learn how to socially interact with their peers i.e. while playing market or house, preparing themselves at the same time for similar future real world engagements (UNICEF, 2018). This type of play develops from 15 months of age with simple actions developing into longer story sequences and role play. Sociodramatic play such as pretend play with others, sustained role taking, and a narrative line become more common from the third year of a child's life. *"It can involve understanding others' intent, sophisticated language constructions, and development of (sometimes) novel and intricate story lines"* (Smith & Pellegrini, 2008).

Much like pretend play, role playing games lack clearly defined winners, losers, or even an ending, making the approach appropriate to enter a classroom setting sans the competitive drama other games could bring. Their emergence as educational tools is highlighted by the documented benefits to cognitive skills. "*Used in a broad range of disciplines, ranging across the spectrum including language arts, mathematics and statistics, social studies, history, and English as a second language*" (Hawkes-Robinson, 2011). RPGs give access to knowledge, improving mental calculation capacity, promoting reading and extending vocabulary through a playful and recreational process, while contributing to the development of empathy, tolerance and socialization, set role playing games in a position to meaningfully motivate and engage students to an interactive story that will drive them to experientially discover and apply knowledge in a wide range of subjects (Grande-de-Prado, Baelo, García-Martín & Abella-García, 2020).

While role playing games are normally a description of character actions there is also the possibility to actively engage the participants through theatrics along with description. Dressing up as the characters they portray, using props in place of the era-appropriate items they would carry and even decorating the room the activity is taking place in, live action encompasses the role playing game turning it into a LARP (Live Action Role Playing Game). This could carry over well in an educational context, since pretend play is integrated in the learning process from the preschool years.

Research has revealed several educational benefits of RPGs, such as allowing access to knowledge in a meaningful way. They promote reading in a playful and recreational way while extending the vocabulary, they provide a useful method for memorizing tasks and improve mental calculation capacity and on a social skills level they contribute to certain attitudes such as the development of empathy, tolerance and socialization (Grande-de-Prado et al., 2020).

2.5 Discussion

As a tool to make educational activities more fun and engaging, gamification is being used from preschool to vocational training. Interaction among the participants of the learning process through a gamified activity, which can be assisted or unassisted by a guiding educator, has proven to be beneficial for success in behavioral shifts or learning accomplishments.

The European Union has taken steps to expand the knowledge and understanding of educators regarding the concept of a gamified learning process. It is funding innovative actions that research gamification benefits in education and enabling Universities, Institutes and Small to Medium Enterprises to establish an operational field where they can develop modern solutions that utilize recent technological advancements in creating a digital learning ecosystem in Europe.

3. Research methods

3.1 Research question

In the previous chapter, we attempted to present the ways gamification in educational concepts is defined and implemented, through a review of the literature on the topic. We also discussed initiatives of the European Union that result in funding for education and research into modern approaches of engaging, stimulating and retaining trainees.

The research questions raised is: How does the European Union support the facilitation of education through gamification?

3.2 Methodology of research

In order to answer this question, we will look into the aspects of projects on gamification, their participation and their results, collecting data available in the official repositories of the respective funding programs. Combining the findings with the available literature we will use SWOT Analysis to assess the implementation of the methodology.

4. Results

4.1 Introduction

The European Union has funded programmes that include the term gamification in an educational context. Since 2014 - 2015, several research and innovation initiatives have received 25 million Euros of funding under the Horizon 2020 while some were also funded by the 7th Framework Programme.

In January of 2016 an event was organized in Brussels by the European Commission, titled “Information and Networking Day on Gaming, Gamification and on Technologies for Learning and Skills”, aiming to discuss Horizon 2020 LEIT Work Programme 2016-2017 and present topics on Gaming and Gamification as well as Technology for Learning and Skills.

4.2 Gamification projects funded by the European Commission

The Community Research and Development Information Service (CORDIS) is the European Commission's primary source of results from the projects funded by the EU's framework programmes for research and innovation (FP1 to Horizon 2020). It aims to bring research results to professionals in the field to foster open science, create innovative products and services and stimulate growth across Europe. This public repository, provides all project information held by the European Commission such as project factsheets, participants, reports, deliverables and links to open-access publications. The term gamification is present in 162 projects funded by the aforementioned framework programmes. Among these, the following 12 are linked to educational applications of gamification.

4.2.1 GAMING HORIZONS

As a multidisciplinary project GAMING HORIZONS is particularly interested in the use of games for learning and cultural development and aims to expand the research and innovation agenda on serious gaming and gamification. Recognizing the importance of gamification - and gaming more broadly, from a socio-economic point of view, as well as the critical and challenging debates that highlight issues such as gender and minority representation and exploitative game mechanics, GAMING HORIZONS’ key contention is the importance of the European ICT community’s engagement with design trends and social themes that have profoundly affected the mainstream and ‘independent’ game development

cultures over the past few years, especially because the boundaries between leisure and serious games are increasingly blurred. The project's objective is to enable a higher uptake of socially responsible ICT-related research in relation to gaming, achieved through a research-based exchange between communities of developers, policy makers, users and researchers, ultimately identifying future directions at the intersection of ethics, social research, and both the digital entertainment and serious games industries. Gaming Horizons' produced an extensive, evidence-based range of outputs targeted at relevant stakeholders in order to influence policies and practices, based on a dialogic redefinition of what video games are and what they can achieve in various contexts, including education and learning.

4.2.2 INLIFE

INLIFE aims to provide an innovative gamification framework targeting both typical as well as special education and social inclusion activities based on Serious Games. INLIFE's core concept leverages on the potential of the Internet-of-Things (IoT) paradigm to directly link actions, decisions and events happening in real-life with in-game educational progress and modern gaming technologies. This bridge strengthens the infusion of gamification into non-leisure contexts, boosting at the same time the creation of new educational methodologies as well as new business opportunities. The challenge INLIFE addresses is to effectively join the forces of gaming industries, IoT technologies and social science research outcomes to support the development of creative and effective applications in education and for social inclusion.

INLIFE created a framework based on an open, layered architecture, consisting of modules supporting agile abstraction methods, model-driven development and transformation technologies, as well as state-of-the-art gaming and human-computer interaction techniques. Enabling the bidirectional, real time communication between the serious game and the surrounding environment, it brings the player in the center of the game while living the reality. Ultimately INLIFE will pave the way for the proliferation of new innovative IoT-based serious games, created also by third parties, featuring enhanced gameplays and educational efficacy, thus establishing new market opportunities for involved stakeholders.

4.2.3 GANDALF

Given the vast amounts of data generated over the last few years, society is faced with the challenge of transforming a world full of data into a data-driven world. Despite the great

progress made, we have limited motivational resources with which to learn and understand our reality. The EU-funded GANDALF project aims to design gamification and datafication solutions that improve learning outcomes for forecasting courses, as well as further explore the gamification effects on learning, user experience and the forecasting accuracy of the users. The project will foster the understanding of data and investigate how to effectively motivate users to explore data insights.

4.2.4 ProSocialLearn

The objective of ProSocialLearn is to increase academic performance and social inclusion through the creation of a new digital game genre. This new digital games platform focuses on helping children acquire prosocial skills necessary for positive relationships, team working, trustworthiness and emotional intelligence.

ProsocialLearn aims to deliver a series of disruptive innovations by building a platform for game development and distribution in order to stimulate technology transfer from traditional game industry to the education sector and address complex factors associated with child development and advanced ICT in school curricula.

Functions including personalised adaptation of game elements, player profiles, game mechanics, visual sensing, identification of prosocial signals from in-game actions and expressive virtual characters will be provided to the developers using an application programming interface (API), enabling SMEs from the traditional game industry to work together with serious games companies to produce a series of exciting digital games targeting European schools.

4.2.5 NEWTON

NEWTON is a large scale initiative to develop, integrate and disseminate innovative technology enhanced learning methods and tools, to create new or inter-connect existing state-of-the art teaching labs and to build a pan-European learning network platform that supports fast dissemination of learning content to a wide audience in a ubiquitous manner. NEWTON focuses on employing novel technologies in order to increase learner quality of experience, improve learning process and increase learning outcome. The NEWTON project goals are to:

1. develop and deploy a set of new technology enhanced learning mechanisms involving multi-modal and multi-sensorial media distribution.

2. develop, integrate, deploy and disseminate state of the art technology-enhanced teaching methodologies including augmented reality, gamification and self-directed learning addressed to users from secondary and vocational schools, third level and further education, including students with physical disabilities,
3. build a large platform that links all stakeholders in education, enables content reuse, supports generation of new content, increases content exchange in diverse forms, develops and disseminates new teaching scenarios, and encourages new innovative businesses.
4. perform personalisation and adaptation for content, delivery and presentation in order to increase learner quality of experience and to improve learning process, and
5. validate the platform impact and the effectiveness of the teaching scenarios in terms of user satisfaction, improvement of the learning and teaching experience, etc. and the underlying technology through an European-wide real-life pilot with 4 different scenarios.

Involving major stakeholders in technology enhanced learning, from content providers, innovative idea creators, technology developers, regulators, associations, schools and teachers, the NEWTON project aimed to validate its findings in a large-scale pilot covering 26 institutions (14 funded from the NEWTON project + 12 partners) in 7 European countries.

4.2.6 Breaking Educational Barriers with Contextualised, Pervasive and Gameful Learning (BEACONING)

The goal of Breaking Educational Barriers with Contextualised, Pervasive and Gameful Learning (BEACONING) is to set a forefront in multifaceted education technologies through large-scale piloting of a digital learning platform that blends physical and digital spaces. As innovation action strategies, pilots combine opportunities for new Information and Communications Technologies (ICTs) in multiple ways that merge learning acquired in formal, non-formal and informal means, developing the skills for today's abled and disabled learners and workforce. The BEACONING platform is a ubiquitous solution that exploits advances in user experience design, mobile communication, location-based and context aware systems, procedural content generation, pedagogy-driven gamification,

learning analytics and cloud technology through innovative integration towards a blended learning space. Focusing on STEM (Science, Technology, Engineering and Mathematics), the cross-subject approach embedded in a Problem-Based Learning model contextualises learning within real world problem solving and applications, amplifying the role of learners in the process of filtering and connecting concepts framed under practical, investigative and exploratory scenarios. BEACONING anticipates the benefits of making cross-subject matter more understandable, fostering the application of subject specialism to other domains. By integrating experiences in a highly engaging, contextualized and personalised manner, learning can reach beyond the barriers of space and time.

4.2.7 Smart Library of Edutainment: technology and gamification at the service of Education

Aiming to resolve the issue of limited and expensive high quality educational apps, the project places technology at the service of education with the mission of helping children 2 to 12 years old learn while having fun using digital devices. To attain this goal, Smart Library collects interactive games and stories so far only available via proprietary apps. Being available for school use, on the go or at home, it allows for access to educational content at any time, while also providing “smart” recommendations to children, their parents and educators.

4.2.8 ENhance VIrtual learning Spaces using Applied Gaming in Education

Envisioning a revolution in the educational landscape by providing students with distance courses and curricula that otherwise would be difficult if not infeasible to be offered, the project aims to offer a solution towards optimizing the learning process in virtual labs and therefore maximize their impact in education. ENVISAGE proposes to migrate knowledge from the neighboring domain of digital games, where the capture and analysis of detailed, high-frequency behavioral data has reached mature levels in recent years. In digital games, Game Analytics is used to profile users, predict their behavior, provide insights into the design of games and adapt games to users. These mature technologies can be readily migrated to learning analytics, especially in the situation of virtual labs as these are delivered online thus enabling detailed tracking of learner behavioral data. Tracking and understanding behavioral data can facilitate decision-making at the design level of a lab, but also can allow for adapting learning content to the personal needs and requirements of students. ENVISAGE thus proposes a data-driven approach to solve the problems of designing, adapting, revising

and evolving virtual labs. This solution also offers social benefits, since enhancing the virtual labs will permit easy and effective access to education and learning educational organizations.

4.2.9 NoOneLeftBehind

Created to take advantage of the opportunities and potential in digital games “No One Left Behind” means to tackle the challenges that are expected to emerge by the rapid changes in the education sector.

By creating a new generation of Pocket Code, a mobile media-rich programming environment for children, the project aims to unlock inclusive gaming creation and experiences in formal learning situations, the project aims to underpin meaningful learning and support children to realise their full potential; by transferring game mechanics, dynamics, assets and in-game analytics from non-leisure digital games SMEs, into Pocket Code, which also may be adapted to academic curricula.

4.2.10 AUGMENTED REALITY INTERACTIVE EDUCATIONAL SYSTEM (ARETE)

Augmented reality (AR) refers to computer-mediated reality that changes a person’s perception by adding data to the real environment considered to be a very effective tool for education. The EU-funded ARETE project aims to build a Europe-wide competitive ecosystem that supports fast dissemination of augmented learning content. ARETE focuses on three pilot studies in STEM, English literacy skills and positive behaviour intervention. The human-centred attitude of the project boosts innovation and creativity, making Europe a world leader of AR and virtual reality in education. The ARETE ecosystem concept will sustain innovation and improve the performance of existing products or services.

4.2.11 Fostering the practical implementation of Open Science in Horizon 2020 and beyond (Foster Plus)

The FOSTER+ project focuses on promoting the practical implementation of Open Science, with activities targeting academic staff, young scientists and policy-makers in particular. Building on the existing FOSTER portal and training materials, FOSTER+ develops more advanced-level and discipline-specific materials that build capacity for the practical adoption of Open Science and promote a change in culture. Disciplinary partners in the life sciences, social sciences and humanities tailor training content to the practices of each domain. Its outcome-oriented workshops, provide participants with tangible skills, such as selecting relevant repositories, understanding how to license research data, and negotiating EU data protection laws.

FOSTER+ developed a multi-module Open Science Toolkit, covering key topics such as responsible research and innovation, research data management, software carpentry, text and data mining, reproducible research and open peer review. It provides e-learning courses delivered for each module via the Learning Management System and materials made available to support face-to-face training delivery. Furthermore, the Open Science Trainer Bootcamp convenes a cohort of trainers with high multiplier potential and equips them to deliver courses within their institution and disciplines. The use of gamification tools incentivise the trainer network to add new content to the portal and run more innovative events. Additionally, enhancements to content maps and learning structures enable individualised learning pathways to be recommended to users, and digital badges will be assigned to reward completion. All of the training content is openly licensed and e-learning materials are provided in open standards for reuse elsewhere.

4.2.12 Inclusive open schooling through engaging and future-oriented science (CONNECT)

Highlighting the importance of ensuring that all young people become more scientifically literate, are included in education and are allowed to benefit from learning experiences that meet their needs, the EU-funded CONNECT project deems it especially necessary today for secondary schools to prepare students for future careers. In order to expand the availability of schooling activities for science education, which currently are mainly in the form of extracurricular activities or reserved for the most talented students, the EU-funded project aims to create an inclusive, sustainable model that will facilitate the adoption of open schooling by a large number of secondary schools through implementing science-action gamification projects in the core curriculum. Moreover, it will use

participatory science approaches with the involvement of students' families as well as universities and enterprises. CONNECT is an inclusive, sustainable model for enabling more secondary schools to adopt open schooling by embedding science-action gamification projects in the core curriculum, using fun approaches of participatory science with families, universities and enterprises to increase students' interest and confidence with science in life.

Table 4.1 - Gamification in Education Projects funded by CORDIS

Project Title	Coordinating Country	EU Contribution	Outcome
Gaming Horizons	United Kingdom	483.427,50 €	Policies
INLIFE	Greece	1.002.400,00 €	Gamification framework
GANDALF	Finland	190.680,96 €	Education research
ProsocialLearn	Spain	3.448.102,13 €	Gamification framework
NEWTON	Ireland	5.618.771,75 €	Education research
BEACONING	United Kingdom	5.902.772,13 €	Educational framework
Smart Library	Spain	1.200.000,00 €	Educational platform
ENVISAGE	Greece	1.035.250,00 €	Educational platform
REVEAL	United Kingdom	997.751,00 €	Gamification framework
No One Left Behind	Spain	2.687.925,00 €	Gamification framework
ARETE	Ireland	3.935.035,00 €	Educational platform

FOSTER Plus	Portugal	925.846,25 €	Educational platform
CONNECT	Greece	1.499.761,25 €	Educational platform

Among the projects related to gamification that were funded by CORDIS, Spain has coordinated the most, specifically 36, with Italy coming second at 24 projects and Greece third, having coordinated 20 gamification projects. On the educational aspect of gamification though, Spain and Greece both coordinated 3 gamification projects each. The United Kingdom has also coordinated 3 gamification projects with an educational focus as we can see on Table 4.1, out of the 14 projects related to gamification it coordinated.

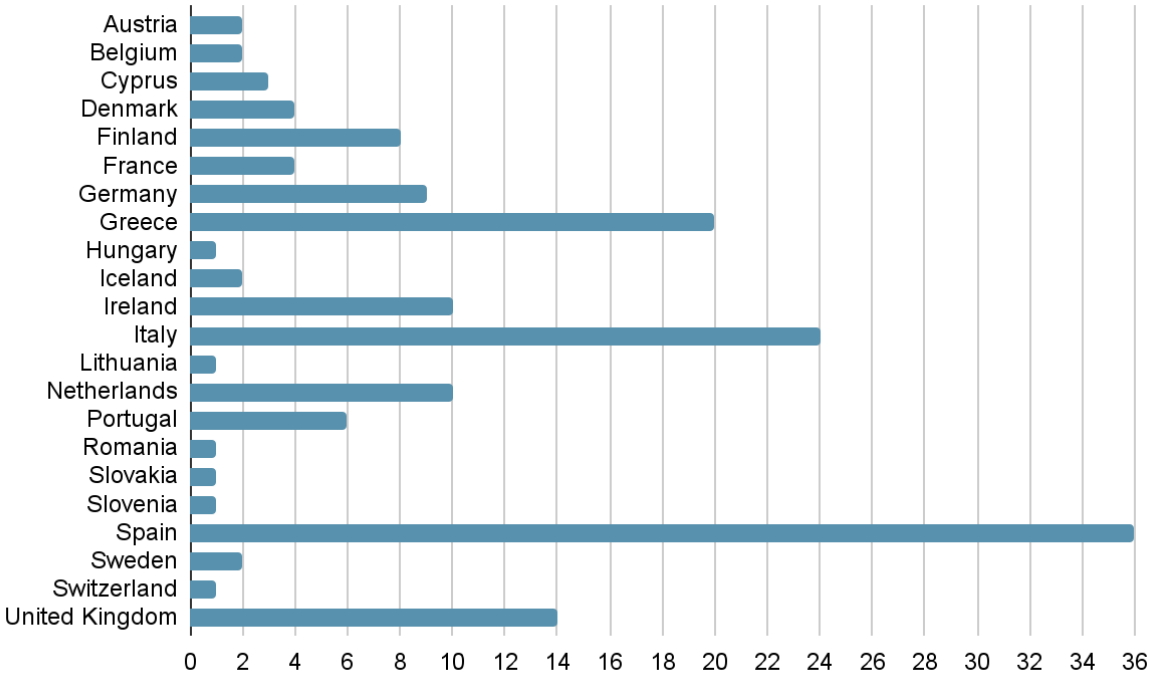

Figure 4.1 - Countries coordinating Gamification Projects funded by CORDIS

4.3 Gamification projects funded by the European Union - Erasmus+

The European Union's programme to support education, training, youth and sport in Europe, Erasmus+, places a strong focus on social inclusion, the green and digital transitions, and promoting young people's participation in democratic life. It also supports priorities and

activities set out in the European Education Area, Digital Education Action Plan and the European Skills Agenda.

Since 2014, Erasmus+ funded 1120 projects featuring gamification in their title or description. Among the 454 projects that are completed, 35 are considered as "good practice examples" and the ones pertaining to education will be shortly discussed in the following pages.

4.3.1 Gamify Your Teaching – increasing vocational competences of entrepreneurship Teachers with the use of gamification

Aiming to support professional development of vocational competencies of teachers and trainers "Gamify your teaching" was a strategic partnership for vocational education and training. In the project's two year duration the goal was to apply an innovative pedagogy and approach to teaching with the use of gamification, in ICT and entrepreneurship teaching, create and test a simulation game with practical elements, as well as the creation of a methodology of teaching through gamification by creating didactic material for teachers. Furthermore a number of case studies regarding real life successful businesses were collected to serve as an inspiration and motivation for the young entrepreneurs.

After conducting a needs analysis, a game was created, based on scenarios and embedded content about entrepreneurship. Furthermore, didactic materials including the description of the game rules and scenarios were developed, in order to support teachers in using the game during their entrepreneurship classes. Finally, 36 case studies presenting successful businesses that could serve as inspiration and motivation for entrepreneurial education were gathered.

4.3.2 Collaborative Learning Environment for engineering education

The general aim of the CoLED project was to develop an innovative collaborative training approach and an online information and communications technology (ICT) training solution for collaborative learning in the field of automation for enterprises. The CoLED project was focused on the development of new dedicated ICT solutions integrated with an e-Learning platform supporting collaboration learning, positive interdependence, individual accountability, face-to-face and online promotional interaction, appropriate use of collaborative skills and group processing among others.

The project's output is the CoLED Methodology, a comprehensive document describing the blended learning methods that were developed. The training model provides the pedagogical framework for the CoLED course implementation, focusing on distance learning (self-paced, e-learning and elements of gamification) and tutoring (synchronous and asynchronous support) and takes into account the specific needs of the target groups. It provides detailed information about the principles of adult education; e-learning principles; the individual learning pathway; peer-to-peer learning; and tutoring. The learning objectives and training content of the CoLED course are described and relevant learning activities are suggested. Additionally, a guideline was provided and a collaborative training platform was created to support the teachers using the methodology. Finally, a practice oriented course on Automation for manufacturing, provides transferable and re-designable training and assessment resources for people interested in introducing solutions for automation and robotics.

4.3.3 Tracing and shaping our linguistic cultural heritage for sustainable plurilingualism, intercultural dialogue and active citizenship

The project aims to develop, refine and widen pupils‘ language skills so that they have become articulate, plurilingual, active citizens eager to participate in society in their role as enlightened Europeans conscious of and united by their cultural heritage. Raising awareness of the rich diversity in the linguistic European heritage, giving priority to project-based learning and integrating principles of entrepreneurial education, allows pupils to experience ownership in their learning process since they became teachers of their mother tongue to their peers, designing learning apps and videos. Through creating and facilitating workshops, games and educational materials, the project contributed to the development of a European identity by providing ample opportunities of collaboration, by engaging pupils in discussions about current European issues and by provoking a meta-cognitive reflection on being an EU citizen.

4.3.4 PLAY-IN: gamification and social innovation to combat the increase of xenophobia in EU

Aiming to contribute in the generation of a more positive and critical view to the European migratory reality promoting social inclusion through innovative tools that will promote the collective construction of a more tolerant and inclusive Europe, from social awareness and fight against racism, radicalism and xenophobia, the project generated an

innovative methodology based on Gamification and a Study about the practical application of this kind of methods, gamification, in favour of social inclusion in Europe. The contents are openly offered to other potential users and organisations.

4.3.5 New Teaching Methodologies

The project aimed to develop relevant and high-quality skills and competencies through the implementation of new teaching methodologies in the daily routines of all participant schools. Furthermore it aimed to support schools to tackle early school leaving. In order to disseminate the aforementioned results, online tools as well as school resources, newspapers and television, from local to international level have been used. The project activities were cut short due to the COVID-19 pandemic.

4.3.6 openVM: Opening Education for Developing, Assessing and Recognising Virtual Mobility Skills in Higher Education

The openVM project aims at promoting and scaling-up Virtual Mobility (VM) in Higher Education (HE) in Europe through achievement, assessment and recognition of Virtual Mobility Skills of HE educators and students in line with the Bologna and Open Education principles. Its key objectives being to the uptake and in consequence the readiness of VM in HE while also improving the achievement and recognition in relevant institutions, educators and students.

By creating a European Learning Hub for achievement, assessment and recognition of VM Skills as a central reference point and developing a set of innovative tools and methods to enhance achievement, assessment and recognition of VM Skills, the project provided a sustainable infrastructure, resources and guidelines for enhancing the aforementioned skills, as well as a tool to design and implement VM in HE in Europe.

4.3.7 SME's tool to prevent burnout

The aim of the project was to prevent burnout at work and raise resilience by developing toolkits for Small and Medium Enterprises (SMEs) staff, management staff, SME owners to help them to forecast burnout, develop coaching and counselling methods and tools, recognize the warning signs, take steps to get balance back and to change peoples' approach to a balanced life, improve working conditions, reduce stress and the cost of burnout.

The outcome was a collection of toolkits, with ways to raise resilience designed for SME managers to help prevent burnout at work. The content helps spot any warning signs at an early stage and ultimately improve employees' happiness in the workplace. The toolkits are linked to the self-assessment on identifying reduced resilience of the employees and the managers training included e-learning components with gamification elements.

4.3.8 Spielend neues lernen

A continuation of the successful implementation of an eTwinning project, aiming to motivate pupils to learn foreign languages, to expand the use of activating elements of the game in foreign language teaching, but also in other subjects and to improve pupils' digital skills. The scenarios and online games developed are available on the project website that acts as a guide and resource for teachers. The accompanying e-magazine informs about the course of the project as well as about the overall experience of the participants. The teachers involved, recognized the benefits of using gamification elements in the classroom and therefore encouraged their colleagues to combine the traditional method of teaching with the use of gamification.

4.3.9 INNOVATION=MOTIVATION: How to be a smart student with a creative mind

The need to introduce continuous educational innovations to keep motivated students who are increasingly exposed to ICT was the driving force of the project. By designing their own apps, the students developed a research work on the possibilities of ICT tools, not only in the educational context, but also in the workplace, making them aware of the digital world and the importance of these tools. At the same time, they deepened their knowledge of the subjects of the educational curriculum and encouraged a good number of students to consider different training options, such as vocational training programs. In addition, thanks to the Gamification and Project-Based Learning methodologies implemented in schools, the participating students have developed an entrepreneurial mind-set, their creativity, the ability to organize ideas, self-improvement and logical thinking have been enhanced.

The main strategic result is the implementation of a completely innovative project where different sectors of the educational community were involved in order to develop their own computer applications fostering creativity and analytical thinking. The activities are accessible from the project website along with the infographics and educational videos created, as well as tutorials for all the applications used to build them.

4.3.10 Creative and Innovative Training Based on Digital Materials and Games

Aiming to prepare new international creative digital learning materials in art, music, english, physical exercise and algorithms, technology integrated game based learning in early childhood education, as well as train teachers in ICT literacy, Educational Technology and Gamification, the project trained educators in using and creating innovative educational content. As a result, scientific papers were authored by the participants, as well as several games, modules and dissemination material along with a project book.

4.3.11 SMART MATHEMATICS TEACHER

Looking to decrease the number of low achievers in math, the project developed mathematics teachers' digital educational culture to enhance pupils' engagement and achievement. By using mobile apps in the teaching process, adopting innovative digital practices and by strengthening the capacity to develop pupils' critical thinking and creativity, as well as to deal with diversity in the classroom, math teachers worked with best teaching practices, presented as Open Educational Resources.

The project collected practical & reusable resources for the practitioners in a website, along with research material bringing forward the reflection in the sector.

4.3.12 Mobile Math Trails in Europe

The project aimed to provide materials and methodology for teachers to create outdoor math activities easily for their classes and for lecturers to create courses for teachers to teach them how to enrich their future classes with mobile math activities.

Derivatives from the project are two mobile applications, one for walking math trails and one for creating math trails. Furthermore, a long-term curriculum for a seminar/course for university students and a short-term curriculum for summer schools, mainly for in-service teachers.

4.3.13 #TV T21 COMmunity# e-Skills, social inclusion and employability (intercultural dialogue in tourism)

Aiming to assist young people with Down syndrome that face psychological, social or physical challenges and that need alternative pathways to engage with education and new technological competences for employability, as well as teachers, stakeholders and relevant professionals involved in the delivery and development of creative and innovative educational responses for young people who do not engage in mainstream educational

settings, this project provided several outcomes and results that contributed to the social and digital inclusion of Down syndrome citizens as well as allowed the development of digital educational contents, methodological and pedagogical guidelines, innovative web platforms and social networks as well as creative short stories eBooks among others. Furthermore it allowed due to its relation with stakeholders, volunteers and teachers, the launch of a unique and innovative training course in Higher Education for young people with intellectual disabilities.

4.3.14 Health Points - A game based approach for Health Promotion

Aiming to improve health literacy among young adults, Health Points developed a game based approach and learning game to provide an attractive access to information on health prevention and education for young disadvantaged groups. Through a training programme and accompanying guide, trainers, educators and youth workers will be equipped with an innovative tool to promote awareness for and provide information on health related topics in their training or in any other context or initiative.

4.3.15 Empowerment for improvement. Successful Intervention and Prevention against domestic violence.

The EMPROVE project aims at empowering domestic violence survivors by improving intervention and prevention and by training counsellors and trainers, as well as NGO staff that works with domestic violence survivors, enriching their training repertoire with the intellectual products that will accrue from the project. Through comprehensive good practice research and qualitative needs analysis of the challenges both counsellors and domestic violence survivors face, train-the-trainer events and the introduction of an innovative element in the training and counselling via a Social Platform, developed based on the theory of Gamification.

4.3.16 Development of a Methodological Training for Company Instructors Providing Work-Based Trainings in the Plastics and Related Industrial Sectors

The Development of a Methodological Training for Company Instructors Providing Work-Based Training in the Plastics and Related Industrial Sectors (DEMETRA) project, reflects on the emerging needs of companies in the plastics and related industries for employing young generations graduated at VET schools. Using a methodology suitable for

generation Z by utilizing game-based learning tools a better match between training and labour market needs is ensured and transition to employment is eased.

4.3.17 Online Training Courses for E+ Youth Workers

The need for proper tools to train youth workers in youth programs, especially E+ in a specific and flexible timeframe that will accommodate the short duration of the projects and the fluctuation in the positions. Through the creation of e-courses for project managers, mentors, facilitators and leaders in youth exchanges where gamification elements were utilized, the project produced a special, innovative structure where hundreds of participants were trained.

4.3.18 KidVenture – increasing the entrepreneurial culture of children through gaming

Aiming to create an innovative computer learning game for Entrepreneurship Education of children between 6 and 10 years old, for use in formal, non-formal and informal education settings. Thoroughly studying the notion of Entrepreneurship Education discipline in order to determine the aspects of the final product, the consortium designed a game representing the convergence of three involved pillars: the academia, the in-service teachers and the private enterprise sector. By creating their own company in the computer game, the students cooperate with each other to reach success by making decisions and developing joint activities in response to different challenges (e.g. assigning different management roles to each member of the group – role playing). The game is accompanied by the entrepreneurial skills framework document and an implementation guide.

4.3.19 Erasmus+ for the immersion in 3D printing of VET centres

The main objective of the project is to train teachers in Computer Aided Design (CAD) aiming to 3D-printing across the majority of school subjects, in order to improve educational transversal skills of the students in VET schools. Furthermore, it aims to enhance the concentration of students with Attention Deficit Disorder.

The platform created by the project provides the user with the opportunity to start training in 3D printing, as well as being able to create exercises themselves to be used in the classroom with the help of the methodology developed. Gamification aspects in the platform, provide the user with motivation and interest in both sharing their exercises and using those

available on the platform, as well as creating their own list of favourite models and exercises, thus giving them more visibility.

4.3.20 An innovative virtual reality educational environment for school physics education

The project aims to assist students in studying physics with the utilization of innovative technologies. Through a 3D virtual reality educational environment with innovative educational infrastructure, offering immersive and efficient learning opportunities, engaging students in various educational activities, learning scenarios and offering students an attractive, entertaining and efficient way to learn various topics of the challenging domain of physics. Among the research material bringing forward the reflection in the sector, a report on Gamification and Learning Opportunities in Virtual Worlds was produced by the project.

4.3.21 Do Well Science

The general objective of the DoWellScience project has been to increase secondary students' learning results in STEM (maths, physics and natural sciences). By providing support to STEM teachers in promoting an interdisciplinary and inquiry-based learning approach to increase students capacity in problem-solving, critical thinking, active research and curiosity towards scientific subjects. The project developed innovative pedagogies for science teaching and learning based on the use of youngsters most diffused communication and information tools as apps for smartphones and tablets and the web as well as full use of ICT communication potential to promote among students a cooperative based and peer to peer learning practice in order to stimulate their commitment to learn scientific subjects.

The teaching package developed is a consistent, scientifically and pedagogically validated, innovative and highly transferable set of operative teaching materials, making use of gamification methods.

4.3.22 Math and Motivation

The main aim of the project was to improve basic skills of secondary school students in the sphere of math and sciences and reduce dropout rate. Through development and testing of a collaborative methodology and implementing it in an on-line e-platform and of a curriculum with lesson plans for improving math, science and literacy skills of school students, as well as improving the competences of teachers into creating and applying

innovative teaching methods and tools (including ICT) in their classroom in order to increase the students motivation, the project innovatively combined three teaching methods, self/peer learning, gamification and flipped learning, into one complex collaborative methodology available in the form of theoretical guidelines as well as a base of an e-learning platform for collaborative learning: an online environment for teachers that supports modern approaches and models in learning.

4.3.23 Introducing Gamification in vocational education and training for professionals and Social Work in the field migrant children protection and support

The GVETS project was created as a response to the recognition of gaps in the VET structures of Europe in the professional development of professionals working with migrant children. By utilizing ICT tools and the innovative pedagogical tool of gamification a training platform was created covering a wide range of topics and competences relevant and essential for those working with children in a migration environment.

4.3.24 Prison, Reintegration, Education. Trainings to support social and labour market (re)integration of people in or after detention

The main goal of the project is supporting the social integration of prisoners and released people in the context of adult learning relations. In order to reduce economical/social and/or political marginalization, create possibilities of (re)integration and actuate social attitude change toward target group members and their problems, the project developed pedagogical materials, methods, curriculums and facilitated knowledge and experience exchange, utilizing the gamification methodology to educate about money management and employment opportunities after release.

4.3.25 Boost Aid for Social Entrepreneurship through Training

Aiming to foster social entrepreneurship in Europe through providing a set of learning and training instruments to educators and investors. A social entrepreneurship development model was created to contribute to the success of social entrepreneurs and the educators were trained on how to train and inspire social entrepreneurs to innovate, use adjusted for social business tools and templates, access to business networks and collected case studies of good

practices and know-how on how to mentor and use new teaching methods based on gamification and visualization.

4.3.26 INTEGRATION THROUGH BLENDED LEARNING

In order to assist teachers and students of the blended learning modality using Moodle and decrease the high rate of desertion among these students. The project detected these difficulties in the use of the platform, proposed solutions and complementary digital tools, promoted bigger participation in the platform through gamification as well as initiatives to reduce the desertion rate. Finally, improvement proposals for blended learning and the adoption of a better common model were presented.

4.3.27 Sharing for leading teacher training from the present to the future

Aiming to impact on a better quality of the teaching-learning process as well as utilize new methodologies and meaningful approaches such as Project Based Learning (PBL), cooperative learning, gamification, Game based Learning (GBL) and Challenge Based Learning, the project has generated tangible products on teacher training models, advisor profiling, management and design of activities, classroom observation and mobile learning models of implementation. Along with the production of four digital magazines with relevant information about active methodologies and innovative lessons, the project contributed to the improvement of professional competences and will allow to teach and educate highly competent citizens.

4.3.28 REALLIFE: serious gaming and virtual reality to develop 21st century and employability skills

Aimed at the social inclusion of prisoners by improving 21th century skills through serious gaming, virtual reality and gamification, Project Real Life developed an innovative blended learning environment for people in closed facilities, in order for them to develop skills needed for employability and life outside the prison were trained in a personalized environment through off- and online exercises.

4.3.29 Innovation in VET for Jobs and Employment

Built on the need to introduce new models of innovation in VET and in all educational systems, the project promoted innovative educational methodologies and approaches for VET, specifically Entrepreneurship education, Work-Based Learning, Creative Problem Solving Methodology, Web 2.0 tools for VET, Gamification, Simulation and Digital storytelling, Open Educational Resources and created a network of European stakeholders interested in the introduction of innovation in Educational system.

4.3.30 CReativity in Action to promote YOung eNtrepreneurShip

CRAYON's project motivated higher education students and recent graduates to stimulate their social entrepreneurship, creativity, innovation and transversal skills. To achieve this goal it developed an innovative methodology including Motivation 3.0, as well as Creativity, Gamification, LEGO® Serious Play and Business Model YOU, enabling entrepreneurs to follow on a journey to better know themselves and their teams and to develop an entrepreneur project.

4.3.31 La classe en action! Échanger de bonnes pratiques innovantes dans l'enseignement des langues étrangères.

Recognizing radical changes taking place in Europe and the need for students to be prepared for an increasingly digitized world, the project used an innovative approach based on student-oriented tasks combining a practical use of information and communication technologies through an efficient use of digital whiteboards, creative work with videos, the concepts "flipped classroom" and "gamification" and interdisciplinary work linking arts and languages.

4.3.32 Games for Learning and Inclusion

Assessing and promoting the effective use of games in technology for working with children with special educational needs, the project used serious games based on gamification as a design approach which leverages, based on expert knowledge and the literature base, understanding about technology design which effectively engages, motivates and guides participants towards learning outcomes based on gamification principles. The partnership

developed the implementation of games as a pedagogical tool that stimulates learning, both formal and informal, in order for students to perform better in formal school settings and be better prepared for the future.

4.3.33 Playing together in our European dream city

Using a wide range of ICT tools and social media, innovative practices and methods (Content and Language Integrated Learning, flipped classroom, gamification) and teaching strategies to actively engage students in their learning process, including group discussions, problem solving, peer-tutoring, cooperative e-book writing, and structured learning groups, the project enlarged the participants' educational background knowledge, enriched creativity and professional standards and helped them develop a greater awareness of Europe and a European sense of identity.

4.3.34 Supporting Open Educational Resources (OER) re-use in learning ecosystems

Targeting the support for the production and adoption of Open Educational Resources (OER), as a strategic priority identified by the European Commission the project aimed to influence the policy development regarding the use of OER. The proposed infrastructures included embedding gaming mechanics in the OER repositories .

4.3.35 Play & Learn Entrepreneurial Skills in the Agricultural Sector

The project aims at developing a digital tool to promote the improvement of entrepreneurial skills in students studying at agricultural VET schools. The development of the main output, was a series of games to improve competences in:

- Responsibility & Risk taking
- Decision making, planning & Leadership
- Cooperation, networking & Communication
- Innovativeness & Creativity
- Time management & Planning
- Information analyzing, processing & Summarizing

Table 4.2 - Gamification in Education Projects funded by Erasmus+

Project Title	Coordinating Country	EU Contribution	Outcome
Gamify Your Teaching – increasing vocational competences of entrepreneurship Teachers with the use of gamification	Romania	176,099.95	Entrepreneurship game
Collaborative Learning Environment for engineering education	Poland	261,289.50	Educational methodology
Tracing and shaping our linguistic cultural heritage for sustainable plurilingualism, intercultural dialogue and active citizenship	Germany	97,718.70	Educational resources
PLAY-IN: gamification and social innovation to combat the increase of xenophobia in EU	Spain	63,650.00	Educational methodology
New Teaching Methodologies	Spain	136,322.36	Educational methodology
openVM: Opening Education for Developing, Assessing and Recognising Virtual Mobility Skills in Higher Education	Germany	416,712.00	Educational framework
SME's tool to prevent burnout	Poland	236,927.14	Educational toolkit
Spielend neues lernen	Slovakia	106,755.00	Educational resources
INNOVATION=MOTIVATION: How to be a smart student with a creative mind	Spain	84,316.00	Educational resources
Creative and Innovative Training Based on Digital Materials and Games	Turkey	399,081.00	Educational resources
SMART MATHEMATICS TEACHER	Lithuania	269,154.13	Educational resources

Project Title	Coordinating Country	EU Contribution	Outcome
Mobile Math Trails in Europe	Germany	390,545.00	Educational resources
#TV T21 COMmunity# e-Skills, social inclusion and employability (intercultural dialogue in tourism)	Portugal	106,645.00	Educational methodology
Health Points - A game based approach for Health Promotion	United Kingdom	273,363.59	Educational toolkit
Empowerment for improvement. Successful Intervention and Prevention against domestic violence.	Ireland	276,232.50	Educational platform
Development of a Methodological Training for Company Instructors Providing Work-Based Trainings in the Plastics and Related Industrial Sectors	Hungary	273,340.59	Educational platform
Online Training Courses for E+ Youth Workers	Romania	182,852.00	Educational platform
KidVenture – increasing the entrepreneurial culture of children through gaming	United Kingdom	331,560.81	Educational platform
Erasmus+ for the immersion in 3D printing of VET centres	Germany	365,243.00	Educational platform
An innovative virtual reality educational environment for school physics education	Cyprus	200,620.00	Educational resources
Do Well Science	Italy	297,955.00	Educational resources
Math and Motivation	Bulgaria	218,125.00	Educational methodology | Educational platform

Project Title	Coordinating Country	EU Contribution	Outcome
Introducing Gamification in vocational education and training for professionals and Social Work in the field migrant children protection and support	Hungary	221,250.00	Educational platform
Prison, Reintegration, Education. Trainings to support social and labour market (re)integration of people in or after detention	Hungary	231,616.94	Educational resources
Boost Aid for Social Entrepreneurship through Training	Bulgaria	249,259.00	Educational resources
INTEGRATION THROUGH BLENDED LEARNING	Spain	64,253.00	Educational resources
Sharing for leading teacher training from the present to the future	Spain	82,670.00	Educational resources
REALLIFE: serious gaming and virtual reality to develop 21st century and employability skills	Netherlands	417,574.50	Educational framework
Innovation in VET for Jobs and Employment	Germany	374,910.00	Educational methodology
CReativity in Action to promote YOung eNtrepreneurShip	Spain	197,606.00	Educational methodology
La classe en action! Echange de bonnes pratiques innovantes dans l'enseignement des langues étrangères.	Germany	110,800.00	Educational methodology
Games for Learning and Inclusion	United Kingdom	146,627.00	Educational resources
Playing together in our European dream city	Italy	131,205.00	Educational resources

Project Title	Coordinating Country	EU Contribution	Outcome
Supporting OER re-use in learning ecosystems	Sweden	225,085.00	Policy influencing
Play & Learn Entrepreneurial Skills in the Agricultural Sector	Hungary	268,259.00	Educational toolkit

Erasmus+ is currently funding 666 projects regarding gamification that are still ongoing.

As we can see in Figure 4.2 Spain and Italy, who have topped the CORDIS funded projects, are again among the most active countries that have completed Gamification Projects funded by Erasmus+, with Poland also ranking among the top three countries. Spain has coordinated and participated in the most projects, 104 and 228 respectively. Poland coordinated more than Italy, 46 to Italy's 32, while Italy had a more active participation with 198 to Poland's 126 projects. Greece follows in the 4th place regarding participation with 112 projects. The country has coordinated 21 projects, less than Turkey (32), Germany (25) and Hungary (24), so ranking in the eighth place.

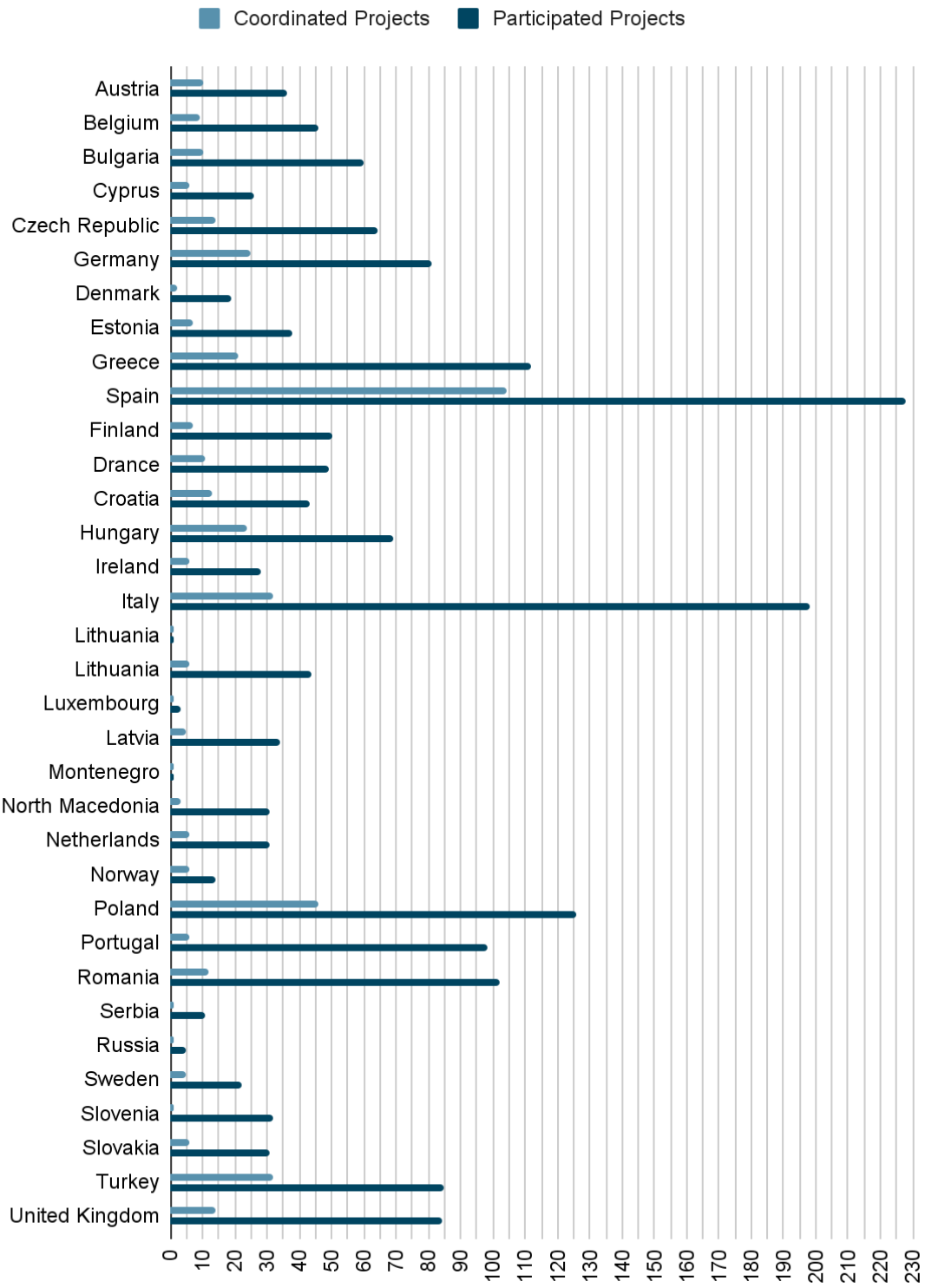

Figure 4.2 - Countries coordinating and participating in completed Gamification Projects funded by Erasmus+

Figure 4.3 shows Spain again in the lead coordinating 170 ongoing Gamification projects and participating in 348. Poland is second, overseeing 53 projects and Turkey comes third with 52. Italy follows with 45 projects and Greece completes the top five with 36 projects. The same countries are in the lead in participation as well with Italy participating in 198, Greece in 169, Poland in 140 and Turkey in 138 projects funded by Erasmus+.

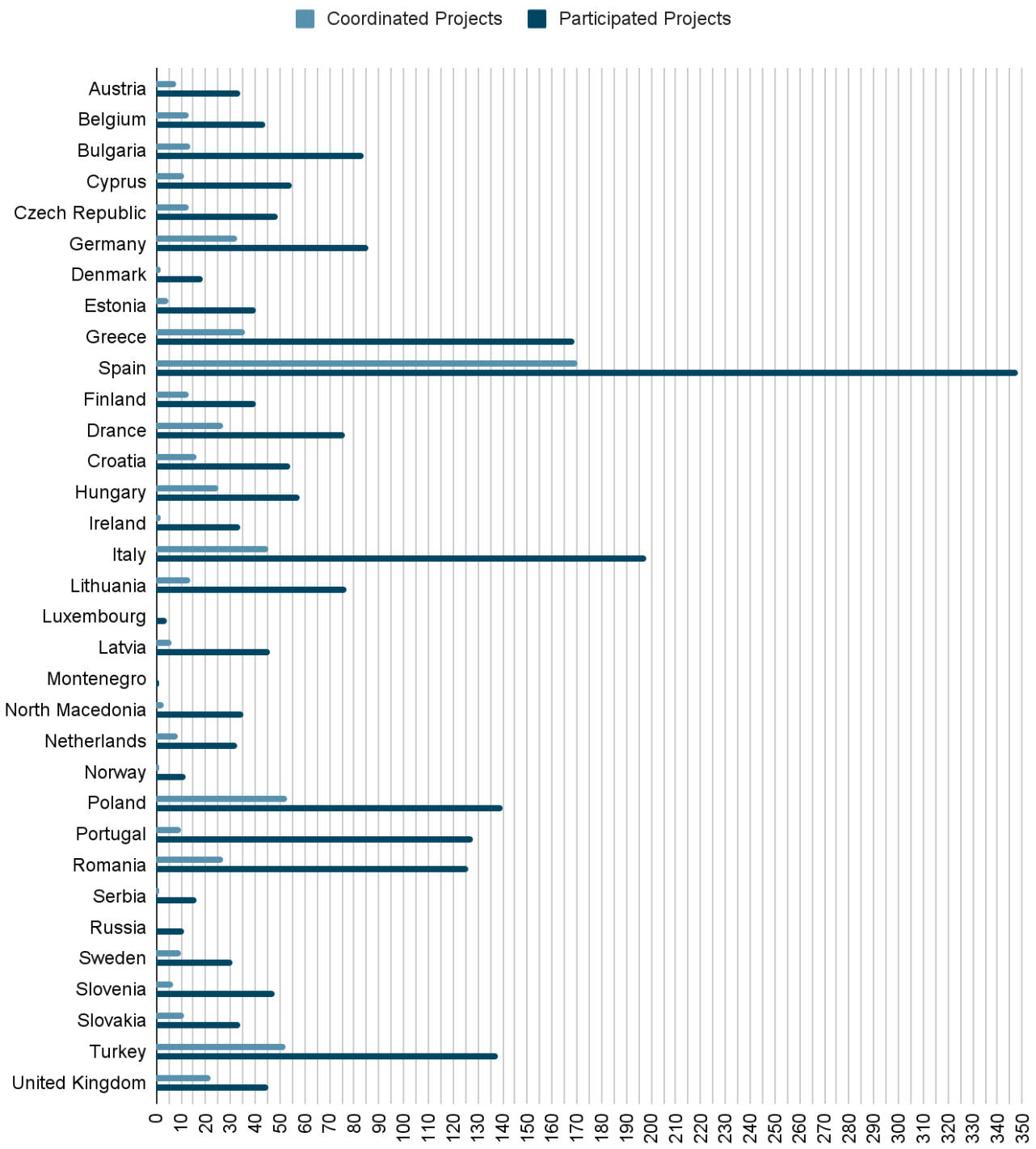

Figure 4.3 - Countries coordinating and participating in ongoing Gamification Projects funded by Erasmus+

4.4 Discussion

While there is a wide range of gamification use in educational environments and a remarkable sum of funds invested, little has been directed towards policy making or directions that will influence formal educational stakeholders to incorporate gamification as a modern methodology that yields results. Combining recent breakthroughs on the topic and technologies that assist in both implementing and disseminate the practice, can provide researchers, policy makers and small and medium enterprises with the opportunity to further gamification in European education across all aspects of the field, from the classroom, to the market, to the bureaucratic chambers that determine how education and training take place across the European Union.

We will attempt to assess the methodology using SWOT analysis, thus describing the strengths, weaknesses, opportunities and threats of using gamification in an educational context. SWOT analysis is used to classify internal enhancers of performance as strengths and internal inhibitors as weaknesses. In turn, external enhancers are categorized as opportunities while external inhibitors are referred to as threats (Leigh, 2010).

As a design and implementation strategy to insert game mechanics in existing contexts, gamification is an effective framework that allows participants to gain a clear perception of the actions required by them in order to participate in a gamified process, shortening the learning curve of the activity and favoring a quick user engagement. Furthermore, the simplicity of implementing gamification practices and techniques especially in digital environments, through ready - made modules that can gather analytics regarding engagement and retention rate, allows for faster creation of gamified activities (Rapp et al., 2019).

On the other hand, some researchers argue about shortcomings of gamification studies in both qualitative and quantitative analyses. Juho Hamari finds that the effectiveness of game elements depends on the contexts in which they are used, especially when social comparison and goal setting are part of the process, similarly to actual games, while in utilitarian services such as e-commerce and finance, their effects seem to vanish. The rewards or achievements lose their luster soon, presenting a need for constant optimization responding to user feedback. This is especially prevalent in applications where the award of points and the advancement of levels are the only elements of gamification present, while the experience is generically designed, instead of being tailored to the users that will engage in the gamified activity (Toda et al., 2018). This can be attributed to a general lack of advancements in

learning standards, professional development for educators and understanding of the value that game elements and play can provide to learning (Unicef, 2018).

The initiatives described in recent projects funded by the European Commision, along with a rekindled interest by scholars looking to be inspired by games, highlight a trend to explore novel techniques for the production of more effective, engaging and enjoyable gamified systems. The upcoming Erasmus+ has a budget increased by 79%, from €14.2 billion during 2014 - 2020, to €26.2 billion complemented with about €2.2 billion from EU's external instruments for 2021 - 2027. (Erasmus+, 2021) Developments in the area of tangibles and wearables that allow interaction with an application can add to the intuitive design of the game, deepening user immersion (Rapp et al., 2019). The projects implemented make use of mobile apps, web applications as a main focus of their initiative and in several cases as a deliverable result to further the scope of gaming in educational contexts.

Examples of an entirely gamified living are present not only in popular fiction but also in social and occupational environments. China has established a scoring system that evaluates aspects such as professional conduct, corruption and commercial habits (Ramadan, 2018). Amazon has developed simple video games similar to the ones available on early consoles, linking physical tasks completion to digital points (Freedman, 2019). While aiming to increase productivity or affect social behaviour, issues of privacy and personal information emerge. Always on and always connected devices may, sometimes inadvertently, reveal data irrelevant to the activity engaged, such as medical information, location history and more. The project ENVISAGE that uses Game Analytics to track and understand behavioral data in trainees mentions no anonymizing procedures for participants, or ways to ensure that no data can be connected to specific users.

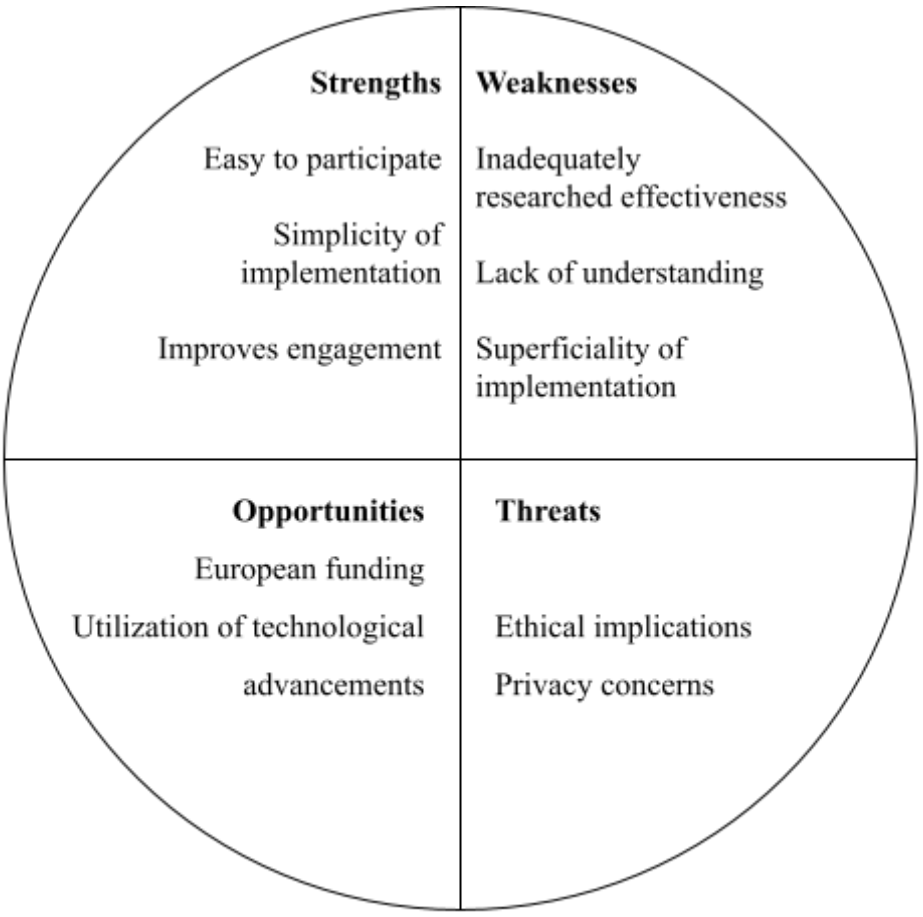

Figure 4.4 SWOT Analysis on Gamification

5. Conclusions

- *"All play and no work makes Jack a mere toy."* (English proverb)

5.1 Summary

While the EU has no formed policy for gamification in education, there is no shortage of projects and initiatives that factor in the learning method both in formal and in vocational training. The Erasmus+ and Horizon 2020 provided the financial means for universities, businesses and schools to co-explore the possibilities of implementing methods using gamified processes, serious games and playful learning in the form of video games, role playing games and platforms implemented through websites and applications.

With skillful design and implementation, gamifications can upgrade the role of school to successfully engage, motivate and retain students. After all, gamification is a methodology that provides tools but regardless of their potential, it is up to what is done with these tools that will lead to results, justifying the investment (Lee & Hammer, 2011).

5.2 Suggestions for further research

A comparative study of how and if gamification is used as an educational and training methodology in the United States as well as in the technologically advanced countries of the far East like China, South Korea and Japan could reveal common practices that can further the efficacy of gamification in education.

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